# Trade Agreements and Incentives for Environmental Quality: A Western Hemisphere Example

*Nicole Ballenger*
*Barry Krissoff*
*Rachel Beattie*

*A simple conceptual model can illustrate the potential for trade and environment agreements to satisfy the objectives of "northern" countries concerned with environmental protection and "southern" countries pursuing export earnings. In a hypothetical empirical example, the United States offers preferential access to fruit juice imports from three Latin American countries in exchange for enhanced protection of farm workers potentially exposed to pesticides during fruit production. Results for this particular case suggest that the benefits of preferential access to the US market substantially outweigh the costs to Latin American countries of adopting pesticide safety regulations similar to those protecting US farm workers. ©1995 by John Wiley & Sons, Inc.**

Requests for reprints should be sent to Dr. Barry Krissoff, USDA, ERS, Trade and Development Analysis Branch, 1301 New York Ave. NW, Washington, DC 20005-4788.

**Future bi- and multilateral trade and investment agreements are likely to include provisions for strengthening environmental standards. The recently negotiated North American Free Trade Agreement (NAFTA), for example, contains several environmental provisions that call for the signatories to work together to enhance the protection of human, animal, and plant life, and health. Further negotiations are anticipated between the United States and Latin American nations, possibly setting the stage for a bargain between groups in "the North" representing environmental objectives and groups in "the South" representing trade expansion objectives.**

**Groups in the United States call for environmental actions in their less-affluent trading partners in the context of trade agreements for several reasons, including:**

1. **pollution, such as air or water contamination, generated in another country can cross bound-**

*The views in this paper do not reflect official positions of the authors' institutions.*

• *Nicole Ballenger and Barry Krissoff are Agricultural Economists at the Board on Agriculture, National Research Council, Washington, DC and the Agriculture and Trade Analysis Division, Economic Research Service, USDA, respectively.*
• *Rachel Beattie is a graduate student in economics at Yale University.*

Agribusiness, Vol. 11, No. 2, 131–138 (1995)

CCC 0742-4477/95/020131-08

aries and adversely affect economic activity or environmental quality in the United States (transboundary effects)*;
2. US citizens may value environmental protection, such as wildlife preservation, in other countries for ethical reasons even though they will never actually use or see the environmental good (existence values); and
3. US producers may feel put at a competitive disadvantage if they are subjected to stricter environmental regulations than their counterparts in other countries.

The above three reasons provide a basis for a coalition between groups concerned about the environment and producer groups concerned about the "levelness of the playing field."

The literature on the interface between trade and the environment is developing rapidly. As examples, Anderson[1] looks at welfare effects of trade liberalization in the presence of externalities; Krutilla[2] analyzes the formulation of an optimal environmental tax in a large open economy; Ludema and Wooton[3] assess the use of trade policy to strategically control transboundary pollution.[1–3] There are some applications of this literature to agriculture.[4–6] As of yet, however, the literature lacks empirical studies of multilateral coordination designed to accomplish the real-world dual objectives of expanding international trade and enhancing environmental performance.

This article looks at trade and environment policy coordination in the context of a preferential trade agreement between a "northern" country concerned with environmental quality and a "southern" country pursuing export earnings. It develops a simple conceptual model that introduces environmental impacts and environmental regulations into a trade model for a single or composite agricultural good. The focus of the conceptual analysis is the scope for an agreement that satisfies the terms of both the North and the South. The article then take a very preliminary look at a hypothetical empirical case in which the United States offers preferential access to three Latin American fruit juice exporters in exchange for a reduction in farm worker exposure to pesticides during fruit production.

## A Simple Trade and Environment Model

In the conceptual model world trade is in a single or composite agricultural commodity among a large importer (C1), a small exporter (C2), and a large rest-of-world (ROW) net exporter.† C1 and C2 are negotiating a preferential trade agreement, whereby C1 would be willing to expand market access to C2 if the agreement results in an environmental improvement. Thus, C1 may ask that C2 impose stricter environmental standards as a condition of market access.‡

We can formalize the negotiations between C1 and C2 as follows:

$$\max_{\mathbf{R},\mathbf{T}} w_1\,\mathrm{dEQ} + w_2\,\mathrm{dXR}_2$$
$$\text{s.t.}\quad \mathrm{dEQ} \geq 0,\quad \mathrm{dXR}_2 \geq 0,\quad \mathbf{R},\mathbf{T} \geq 0 \tag{1}$$

where $w_1$ and $w_2$ are negotiating weights; $\mathrm{dXR}_2$ is the change in C2's export revenue, which is assumed to be its principal objective; dEQ is the change in total environmental quality in both countries, which is assumed to be C1's principal objective; and **T** and **R** are vectors of tariffs and unit costs of environmental regulations.§ In other words, the objective of the negotiation is to choose

*Note that the transboundary effects can be indirect. For example, farm worker exposure to pesticides may not create a near-term transboundary externality. But if farm workers migrate, their health problems may become a burden on the health system of the receiving country.

†Although negotiations often focus on commodity issues, environmental policy should take into account cross-commodity effects. This analysis could be expanded to a multicommodity framework.

‡For analytical convenience, the conceptual model assumes that any agreement would cause adjustments only in C1 and C2, such that a change in the price at which the good is traded is due only to the actions of C1. In other words, in addition to C2 being "small," export supply of ROW is assumed to be perfectly inelastic. We relax these assumptions in the empirical model.

§Other statements of the two countries' objectives are also possible. For example, producers might value producer surplus more than export revenue. Export revenue was chosen as a realistic country goal and for analytical convenience.

the tariff and environmental policy levels that maximize a weighted sum of the two countries' objectives. To complete the problem:

$$\begin{array}{lll} XR_2 & = P \ * \ (S_2 - D_2) & \\ EQ & = EQ(S_1, S_2, \mathbf{R}_1, \mathbf{R}_2) & d\mathrm{EQ}/dS \leq 0; d\mathrm{EQ}/d\mathbf{R} \geq 0 \\ S_1 & = S_1(PP_1(P + \mathbf{T}_1, \mathbf{R}_1)) & dPP_1/d\mathbf{R}_1 < 0 \\ S_2 & = S_2(PP_2(P, \mathbf{R}_2)) & dPP_2/d\mathbf{R}_2 < 0 \\ D_1 & = D_1(CP_1(P + \mathbf{T}_1)) & \\ D_2 & = D_2(CP_2(P)) & \end{array}$$

where $P$ is the traded price of the agricultural good; $S$ and $D$ are supply and demand functions for C1 and C2; and PP and CP are producer and consumer prices, adjusted for tariffs (**T**) and unit regulatory costs (**R**). Additional assumptions are that in each country environmental quality declines monotonically as production of the good increases; that environmental quality responds positively to environmental policy; and that environmental policy (at least implicitly) taxes producers resulting in backward shifts of (short-run) supply functions.

Potential outcomes of the negotiations are depicted in Figure 1. A feasible negotiated solution would have to fall in quadrant I, where both $dXR_2$ and $d$EQ are nonnegative. Free trade with no new environmental regulation (that is, $w_1 = 0$ and $w_0 = 1$, $\mathbf{T} = 0$) could result in an outcome like $c$ or $d$. At $c$ free trade raises export revenue for C2 but decreases total environmental quality. This could happen because opening trade shifts production toward a more environmentally vulnerable region, to the less-regulated country, or to the country employing the less environmentally friendly technology. At $d$, by contrast, free trade is good for environmental quality (perhaps because it shifts production toward a less environmentally vulnerable region or toward a region employing a less damaging production technology).

If free trade results in point $c$, then C1 will seek the imposition of an environmental policy in C2 that moves the outcome to at least point $a$. The imposition of a very strict environmental policy could result in an outcome closer to $b$, where gains in environmental quality are significant but gains in export revenue are eliminated. Varying weights $w$ would trace out the trade-environment possi-

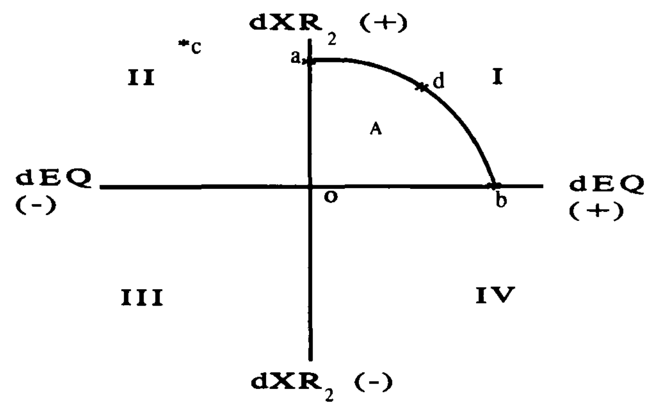


**Figure 1.** Potential outcomes of a trade and environment negotiation.

bilities frontier. While the actual shape of the frontier is unknown, the assumptions of upward-sloped supplies, inverse relationships between production of the good and environmental quality, and the small country assumption for country 1 support the stylized image in Figure 1.||

The nature of the trade-environment tradeoff and the potential for a negotiation to improve both export earnings and environmental quality is shown in Figure 2 from the perspective of C2. The top panel is the usual diagram of supply and demand for the private good. The bottom panel relates the production of the private good inversely to environmental quality along a transformation function, $TR$. Imposing an environmental policy, $R$, means that producers must shift to a higher private cost (but environmentally friendlier) technology, that is, from a transformation function $TR^0$ to $TR^1$.

Removing the tariff, T, in C1 increases the price facing C2 from $P^0$ to $P^1$. Production expands from $Q^0$ to $Q^1$ based on the technology underlying $TR^0$. Because of the production change, environmental quality declines along the frontier $TR^0$ from point $e$ to point $f$. Imposing an environmental regulation shifts the frontier representing the transformation between EQ and $Q$ to $TR^1$. It also, however, raises marginal cost of production, shifting the supply function back from $S$ to $S^1$. Based

||Note, however, that if C2 is large also, then imposition of a supply-reducing environmental policy can potentially improve both export revenues and environmental quality.

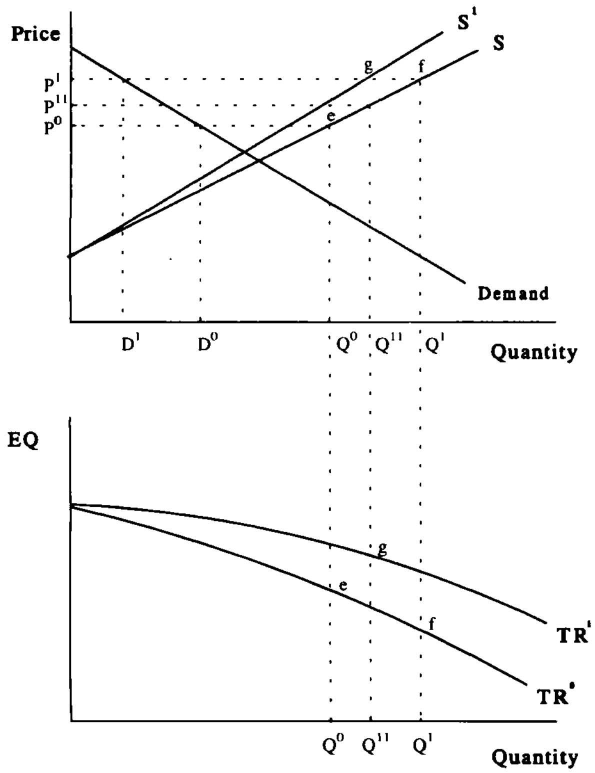


**Figure 2.** Impacts in the exporting country of greater market access and stricter environmental control.

on the higher-cost technology, production falls to $Q^{11}$, which is still above $Q^0$, and EQ improves to point $g$ on $TR^1$. In sum, the change in C2's export earnings $[(P^1(Q^{11} - D^1) - P^0(Q^0 - D^0)]$ is, as drawn in this example, unambiguously positive, as is the net change in environmental quality (assuming that production of the good has declined in C1). (Note that the regulation-induced shift from $TR^0$ to $TR^1$ imposes an implicit environmental "tax" on producers, which is represented by the difference $P^1 - P^{11}$ at $Q^{11}$, and that the producer welfare effects associated with the combination of trade liberalization and environmental policy are ambiguous. C2's consumers lose unambiguously, but net welfare is potentially higher than prior to the negotiation.¶

¶The analysis assumes that there are no societal benefits to the exporting country flowing directly from the improvement in environmental quality, that is, external costs within the country are assumed to be 0. If there were, then the area gained under the marginal external cost curve would be added to the welfare impacts.

Although negotiating weights may not be known, some boundaries can be put on the negotiations. For example, the maximum environmental control (regulatory tax) that C2 would be willing to accept in return for preferential access to C1's market ($T = 0$) can be determined. Additionally, the minimum environmental control acceptable to C1 can also be found. These calculations follow.

If maximizing export earnings is C2's negotiating objective, then the percent change in export revenue after the environmental policy is introduced must be $\geq 0$, that is, $XR_2^* \geq 0$. By differentiating $XR_2$ and setting the resulting expression equal to 0, we can solve for the maximum environmental tax. Referring to

$$XR_2 = P * (S_2 - D_2). \qquad (2)$$

Totally differentiating Eq. (2) results in

$$XR_2^* = P^* + m_{s_2} S_2^* - m_{d_2} D_2^* \qquad (3)$$

where $P^*$ is the percent change in world price when C1 removes its tariff and $m_{s_2}$ and $m_{d_2}$ are supply and demand values relative to export revenue, respectively. Equation (3) can be restated in terms of policy variables by solving for $P^*$, $S_2^*$, and $D_2^*$. This yields

$$XR_2^* = \phi_1/\phi[(S_1 s_1 pt_1 - D_1 d_1 ct_1)T_1^* - (S_2 + \phi/\phi_1 m_{s_2}) s_2 pr_2 R_2^* - S_1 s_1 pr_1 R_1^*] \qquad (4)$$

where $\phi$'s are made up of share parameters and supply and demand elasticities: $d_1$ and $d_2$ are nonpositive price elasticities of demand; $s_1$ and $s_2$ are nonnegative supply elasticities; $ct_1$ and $pt_1$ are the ratios of the import tariff relative to the consumer and producer price; $cp_1$, $pp_1$, and $pp_2$ are the ratios of the trade price to the consumer and producer prices; $pr_1$ and $pr_2$ are the ratios of the unit regulatory cost relative to the producer price;

$$\phi = -(S_1 s_1 pp_1 + S_2 s_2 pp_2 - D_1 d_1 cp_1 - D_2 d_2 cp_2) < 0 \quad \text{and} \quad \phi_1 = 1 + m_{s_2} s_2 pp_2 - m_{d_2} d_2 > 1.$$

If neither C1 nor C2 change their existing environmental regulations ($R_1^* = 0$; $R_2^* = 0$), then Eq. (4) reduces to

$$XR_2^* = \phi_1/\phi(S_1 s_1 pt_1 - D_1 d_1 ct_1)T_1^* \qquad (5)$$

which, when $T_1$ is reduced to 0, defines the largest gain in export revenue achievable by C2.

Returning to Eq. (4), we can set $XR_2^* = 0$ (and $R_1^* = 0$) to solve for the value of $R_2^*$ that represents the maximum increase in environmental regulation that C2 would be willing to accept:

$$R_2^*\max = 1/\phi_2(S_1 s_1 pt_1 - D_1 d_1 ct_1)T_1^* \qquad (6)$$

where $\phi_2 = (S_2 + \phi/\phi_1 m_{s2})s_2 pr_2 < 0$. (If C2 is a small country case, the term $S_2 s_2 pr_2$ drops out.)

We can then ask if the range $R_2^* = 0$ to $R_2^*\max$ contains an environmental quality outcome acceptable to C1? That is, is $dEQ \geq 0$ satisfied in this range? The net effect on environmental quality of production shifts following a free trade agreement can be found by differentiating the environmental quality equation,

$$EQ^* = es_1 S_1^* + es_2 S_2^* + er_1 R_1^* + er_2 R_2^* \qquad (7)$$

where $es_1$ and $es_2$ are environmental quality elasticities with respect to production and have nonpositive signs; and $er_1$ and $er_2$ are environmental quality elasticities with respect to regulation and have nonnegative signs. As discussed in an earlier part of the paper, the sign of EQ* is indeterminate. The minimum environmental policy that C1 will accept ($R_2^*\min$) can be found by setting $EQ^* = 0$ and solving for $R_2^*$

$$R_2^*\min = 1/\phi_4(S_1 s_1 pt_1 - D_1 d_1 ct_1 + \phi/\phi_3 es_1 s_1 pt_1)T_1^* \qquad (8)$$

where $\phi_3 = es_1 s_1 pp_1 + es_2 s_2 pp_2 < 0$ and $\phi_4 = S_2 s_2 pr_2 + \phi/\phi_3(es_2 s_2 pr_2 + er_1)$, which has an indeterminate sign. If $R_2^*\min < 0$, then C1 will not seek an environmental regulation in C2; otherwise, it will.

If the minimum regulation acceptable to C1 is less than the maximum regulation acceptable to C2, then an agreement can be struck. A sufficient condition for $R_2^*\min$ to be less than $R_2^*\max$ is that $\phi_4 > \phi_2$ (in absolute value). The magnitude of the environmental quality elasticities are key factors determining $\phi_4$, while the share of exports in total production (parameter $m_{s2}$) is key for $\phi_2$. Also, because the parenthetic term in Eq. (8) is less than the parenthetic term in Eq. (6) due to $\phi/\phi_3 es_1 s_1 pt_2 < 0$, $R_2^*\min$ can be less than $R_2^*\max$ even if $\phi_4$ is not greater than $\phi_2$.

## An Empirical Example of Fruit Juice Trade and Farmworker Protection

The model developed above could be applied to a range of trade and environment problems. For example, the trade-off between agricultural exports and wildlife habitat like forests and wetlands, or between agricultural exports and water contamination due to soil erosion and runoff could be explored. In this study, the model was applied to the case of fruit juice trade and farm worker exposure to pesticides during fruit production. The example was chosen because of the commodity's expected relative importance in a trade negotiation in the Western Hemisphere and because of the relative ease of calculating the regulatory burden to foreign producers of enhancing farm worker safety protections. The regulatory costs are derived from an Environmental Protection Agency (EPA) regulatory impact analysis of US regulations to protect farm workers from pesticide exposure.[7]

### *Fruit Juice Trade*

In 1990, the United States purchased approximately \$775 million or nearly 80% of its fruit juice imports from Latin America: 54% of US fruit juice imports came from Brazil, 10% from Mexico, and 8% from Argentina.[8] The average US tariff on imports of fruit juices is about 15%. At the same time, Latin American fruit juice exporters rely heavily on US markets. Sixty percent of Brazilian fruit juice exports, mostly composed of frozen concentrated orange juice, are shipped to the United States. For Mexico and Argentina, the United States accounts for over 90 and 60% of exports. Approximately 80% of Mexican juices exports are orange juice, but Argentina's are primarily apple juice.

### *Farm Worker Protection*

Oranges and apples are pesticide-intensive crops. The EPA issued standards to reduce the health risks associated with the use of pesticides in the *production* of these and other crops in 1974 and amended them in 1991. The health risks from occupational exposures to pesticides include acute effects (such as pesticide poisoning), allergic or sensitization effects (such as skin rashes), and delayed effects (such as cancer). Standards provide for notification, training, personal protective equipment, reentry intervals, and decontamination and emergency procedures.[9] The notification requirements entail posting and oral warnings after application of toxicity I pesticides, and oral warning or posting for other pesticides. The required personal protective equipment for pesticide handlers also depends on the toxicity level of the pesticide. For toxicity level I and II, the regulations require coveralls, gloves (nitrile), chemical resistant shoes (waterproof boots), eye protection (goggles, a face shield, or safety glasses), respiratory protection (a nondisposable respirator with cartridges or a disposable dust/mist cup-style respirator), and protective headgear (a hat or a hood). Those involved in mixing and loading must also have a chemically resistant apron but not protective headgear. All of these items must be provided and cleaned by the employer. For both toxicity level I and II and for toxicity level III and IV, early entry workers need a hat, long-sleeved shirt, trousers, and shoes and socks.

The restricted entry intervals (REI) establish periods after pesticide application during which entry into a field is restricted. Only workers with protective gear may enter the field and only for short-term tasks or in emergencies.[#] Within 30 days of the end of a restricted entry interval, decontamination standards require employers to provide water, soap, and towels within 1/4 mile of fields for routine and emergency washing.

The EPA's RIA was used to estimate the costs of all farmworker pesticide safety regulations and pesticide use shares were used to allocate the costs to oranges and apples. It was assumed that orange and apple production have the same cost patterns as all fruit production with the exception of reentry intervals. Apples and oranges have more flexible harvest times so the costs of reentry intervals would be minimal. The estimates also incorporate the regulatory costs to commercial handlers, assuming that this cost is passed on to growers.

According to USDA data on pesticide use, orange and apple production use 2.1 and 1.6% of all agricultural pesticides applied.[10] The estimated producer cost per acre of these pesticide regulations is $6.09 for the first year and $3.58 for the out years. (Estimates of enforcement costs are not included.) With the cost of production of Florida and California oranges at $1310 and $2292 per acre, respectively, and of Washington State apples at $4110 per acre in 1991, the regulatory cost share is no more than 0.5% and could be as low as 0.08% in the out years.[11,12]

There is some evidence that worker protection standards are less strict and relatively poorly enforced in Latin America, although relatively little information is available.[13,14] Accordingly, the empirical exercise assumes that a preferential trade agreement favoring Latin American fruit product exports would increase farm worker exposure. It also assumes that the production technology is similar in Latin America and the United States, with the exception of the regulatory requirements. It is recognized, however, that Latin American producers may have higher labor requirements than US producers and use a different mix of pesticides. If so, then different expenditures on worker safety would be required to attain the same level of protection afforded US workers. Additionally Latin American nations may face greater enforcement barriers than in the United States.

### *Empirical Estimates*

The empirical analysis employs a single-commodity Armington-style trade model useful for analyzing

[#]Toxicity level I pesticides require a 48-h restricted entry interval, toxicity level II require a 24-h REI, and all other pesticides require a 12-h REI. Toxicity level I organophosphates require a 72-h interval in arid areas. Toxicity level I pesticides are 30.5% of all pesticides applied, toxicity level II, 18.0%, and all others 50.8%. For vegetable, fruit, and nut crops, the use of toxicity level I is 33.8%, toxicity level II, 23.9%, and toxicity level III, 41.7%.

the implications of preferential trade agreements because like commodities from different countries are differentiated.[15] The model was used to explore three parameters of a possible trade and environment agreement derived from the conceptual model:

1. a maximum level of trade revenue earned by the exporter (Mexico, Argentina, and Brazil, MAB) when the importer (United States) removes its tariff;
2. a maximum environmental "tax" acceptable to the exporter ($R_2^{*}$max); and
3. a minimum environmental regulation in C2 acceptable to the importer ($R_2^{*}$min).

In order to obtain an empirical result for parameter 1, the US tariff on fruit juices from MAB was removed. The results indicated that Mexico's export revenue would increase by 17%, Argentina's by 12%, and Brazil's by 11%.

To obtain parameter 2, the maximum environmental policy acceptable to C2 ($R_2^{*}$max), the US import tariff was removed and the production costs of MAB were allowed to increase (to reflect the imposition of environmental regulations) until the negative effect on supply offset the removal of the US import tariff so as to return export revenue to the base value. The endogenously determined environmental taxes equaled 50, 45, and 41%, respectively for MAB. These large acceptable taxes reflect the importance of MAB to the juice market. When each of the three countries impose additional costs on their producers, world juice supply is reduced raising world market prices and generating additional trade revenue. Thus, to find an outcome where there is no change in trade revenue requires a significant backward shift in MAB supplies.

Determining a value for parameter 3, the minimum environmental regulation acceptable to C1 ($R_2^{*}$min), would require knowing the functional relationship between fruit production and farmworker health. However, a likely proxy for $R_2^{*}$min could be the US standard. In other words, MAB could be asked to adopt comparable worker safety regulations to those in the United States. An exogenous shift of the supply curves of 0.5% for each of the three countries captures the increased environmental regulatory costs. With this supply curve shift MAB trade revenues fall, but by only marginal amounts. For MAB these additional costs fall well within the 0 to $R_2^{*}$max range, suggesting that an agreement between the United States and these Latin American countries could result in both expanded trade and enhanced farmworker protection.

## Conclusions

The empirical analysis was narrowly focused on fruit and one environmental quality issue related to its production: worker safety and pesticide use. The costs of implementing worker safety regulations similar to those of the United States in MAB was found to be far less than the benefits to these countries of increased US market access.

Clearly, there are other environmental concerns connected with fruit production, such as the impacts of pesticide use on water quality and wildlife habitat, which are not considered in this analysis and for which much more information is needed. The costs of implementing policies to improve a broader spectrum of environmental indicators may exceed the "acceptable" limit for a country provided market access; however, this is an empirical question to be further explored. Additionally, the limited empirical knowledge of damage functions greatly constrains estimates of the minimum policies necessary to satisfy the terms of a trade-environment negotiation.

## References

1. Kym Anderson, "The Standard Welfare Economics of Policies Affecting Trade and the Environment," in *The Greening of World Trade Issues*, Kym Anderson and Richard Blackhurst, Eds., Harvester–Wheatsheaf, New York, 1992.
2. Karry Krutilla, "Environmental Regulation in an Open

Economy," *Journal of Environmental Economics and Management*, *20*, 127 (1991).

3. Rodney D. Ludeman and Ian Wooten, "Cross-Border Externalities and Trade Liberalization: The Strategic Control of Pollution," Paper presented at the Allied Social Science Meetings, January 1993.
4. David G. Abler and James S. Shortle, "Environmental and Farm Commodity Policy Linkages in the U.S. and the EC," *European Review of Agricultural Economics*, *19* (1992).
5. Kym Anderson, "Agricultural Trade Liberalization and the Environment: A Global Perspective," *The World Economy*, *15*, 153 (1992).
6. Ford C. Runge, "Environmental Effects of Trade in the Agricultural Sector," Working paper P92-1, Center for International Food and Agricultural Policy, University of Minnesota, St. Paul, MN, 1992.
7. US Environmental Protection Agency, *Regulatory Impact Analysis of Worker Protection Standards for Agricultural Pesticides*, Office of Pesticide Programs, Washington, DC, August 1992.
8. Food and Agricultural Organization of the United Nations (FAO), *FAO Trade Yearbook*, various issues, FAO, Rome.
9. US Environmental Protection Agency (EPA), *EPA's Pesticide Programs, EPA, Washington, DC, May 1991.*
10. *US Department of Agriculture, Agricultural Chemical Usage 1991 Fruits and Nuts Summary,* National Agricultural Statistics Service, Washington, DC, June 1992.
11. Boyd M. Buxton, *Costs of Producing Oranges in California and Florida, 1988/89*, Economic Research Service AER No. 650, US Department of Agriculture, Washington, DC, June 1991.
12. US Department of Agriculture, *Fruit and Tree Nuts Situation and Outlook Yearbook*, Economic Research Service TFS-263, Washington, DC, September 1992.
13. David G. Abler and Daniel Pick, "NAFTA, Agriculture and the Environment in Mexico," *American Journal of Agricultural Economics*, *75*, 794 (1993).
14. US General Accounting Office, *Food Safety and Quality: Five Countries' Efforts to Meet U.S. Requirements on Imported Produce*, GAO/Resources, Community, and Economic Development Division, Washington, DC, March 1990.
15. Barry Krissoff and Jerry Sharples, "Preferential Trading Arrangements in Western Hemisphere Countries," *Agricultural and Resource Economic Review*, *22*, 45.

## Bibliography

Sandra Archibald, Robin Marsh, and Celina Robledo, *Shared Markets, Shared Risks: Pesticides in Mexico and the United States*, Stanford University, Stanford, CA, 1988.

Raul Branes, *Institutional and Legal Aspects of the Environment in Latin America*, Inter-American Development Bank, Washington, DC, 1991.

John U. Davis, Julie A. Caswell, and Carolyn R. Harper, "Incentives for Protecting Farm Workers from Pesticides," *American Journal of Agricultural Econonmics*, *74*, 907.

Carolyn R. Harper and David Zilberman, "Pesticides and Farm Worker Safety," *American Journal of Agricultural Economics*, *74*, 68 (1992).

Craig D. Osteen and Philip Szmedra, *Agricultural Pesticide Use Trends*, Econ. Res. Serv. AER No. 622, US Department of Agriculture, Washington, DC, September 1992.

Jack L. Runyan, *A Summary of Federal Laws and Regulations Affecting Agricultural Employers, 1992*, Econ. Res. Serv. AIB No. 652, US Department of Agriculture, Washington, DC, August 1992.

Valeria A. Wilk, *The Occupational Health of Migrant and Seasonal Farmworkers in the United States*, Farmworker Justice Fund, Inc., Washington, DC, 1986.